REMARKS

Claims 1 and 34 are amended. Claims 19 and 47 are cancelled. Claims 1, 2, 4-14, 16, 18, 20-25, 34-42, 44-46, 48-51 and 65 are in the application for consideration.

Affirmation of the Group 1 election is hereby made. The Group 2 claims 13 and 38 remain in the application.

Claims 16 and 18 stand rejected under 35 USC §112, first paragraph. Further, the Examiner by implication apparently alleges that Applicant's specification is only enabling for a portion of the subject $(CH_3)_xSiO_y$ layer to remain as that composition upon exposure to oxygen plasma. Applicant disagrees and requests reconsideration.

With respect to the inference that the specification is only enabling for a portion of the layer having to remain substantially chemically the same upon exposure to an oxygen containing plasma, see the specification at p.10, ln.16-p.12, ln.9. There, Applicant gives specific examples and clearly teaches that such processing does not necessarily transform a whole or all of the dielectric layer from one base chemistry to another by the exposing. Such further provides that an outermost portion of the exposed layer might experience a slight reduction in carbon content, but otherwise that portion and the whole of the layer is not transformed from one fundamental chemistry to another even inspite of the low k reducing or resulting property. Therefore, the specification is enabling for all of the layer to substantially remain chemically

the same. Accordingly, after treatment, the dielectric layer subject to the exposing is disclosed and taught to include remaining as $(CH_3)_xSiO_y$ after the exposing, and therefore, claims 16 and 18 are in compliance with 35 USC §112, first paragraph.

The Examiner asserts that the prior art cited in paragraph 5 of the action "clearly indicates that the oxygen phase necessarily reacts with the methyl function, thereby breaking the bonds." This is in error. Regarding Wang et al. in this regard, no such disclosure is seen within the reference. That portion allegedly pertinent to Applicant's disclosure from Wang et al., and upon which the Examiner relies in making a prior art rejection, is found at col.5, lns.3+. However, that portion of the Wang et al. patent is only referring to photoresist stripping using an oxygen containing plasma, and is not seen to be material to oxygen plasma exposure to the layer which Applicant specifically recites in claims 16 and 18.

Regarding Morita, the English abstract only provides that the substrate having an "organic silicon layer" is exposed to oxygen plasma. This is no way supports the Examiner's conclusion that the reference clearly indicates that the oxygen plasma necessarily reacts with the methyl function, absent a complete translation of the document.

Brinker et al. is equally lacking in this regard. Such states that "[o]ptionally, chemical treatment such as ozonolysis, oxygen plasma, photolysis, and selective dissolution can be used to remove residual organic constituents

in order to confer additional porosity on the film". col.5, lns.25-28. No other pertinency to the Examiner's point is seen in the reference. Yet this further does not "clearly indicate that oxygen plasma necessarily reacts with the methyl function" [emphasis added] as the Examiner would assert.

For the foregoing reasons, withdrawal of the 35 USC §112, first paragraph, rejection of claims 16 and 18 is requested.

Independent claim 1 stands rejected as being obvious over a combination of Morita and Matsuura. Applicant disagrees and requests reconsideration. At the time of submission of this amendment, the undersigned does not have a complete English translation of the Morita document. The Examiner asserts that Morita discloses forming material comprising phenol or alkyl silicon oxide. No such reference is made in the English abstract included with the Japanese language publication which was provided by the Examiner. Reference is found in the application to $(C_6H_5)_nSi(OH)_{4-n}$; $RnSi(OH)_{4-n}$ and $Si(OR)_4$. No chemical formula reference is seen to that which Applicant recites in claim 1, namely, $(CH_3)_xSiO_y$. Apparently, the Examiner asserts that the document discloses exposing a $(CH_3)_xSiO_y$ to a plasma comprising oxygen. However, the Examiner relies upon an apparent portion of the Morita et al. document which is not yet translated into the English language. If the Examiner has a complete translation of that section, provision of such translation is requested. Absent such a translation, and by referring to the chemical formula provided within

the untranslated document, perhaps the reference is only disclosing a fundamental process by which a dielectric layer is deposited, such as in the manner Applicant describes in the specification at p.6, ln.21 - p.8, ln.15 whereby the layer is transformed from one base chemistry to another. Such merely describes an exemplary process for depositing $(CH_3)_xSiO_y$. Claims 1 and 34 are amended to recite that a whole of the dielectric layer subjected to the exposing is not transformed from one base chemistry to another. Morita does not inherently teach or suggest treating such a deposited layer with a plasma comprising oxygen in the manner which Applicant discloses and claims. Accordingly, absent the Examiner providing a literal translation of the applied language, Morita et al. is not seen to disclose exposing a dielectric layer consisting essentially of $(CH_3)_xSiO_y$ to a plasma comprising oxygen after forming such dielectric layer.

The secondary reference, Matsuura, is equally lacking in this regard. Matsuura is seen only to disclose using an alkyl silane and H_2O_2 in the chemical vapor deposition of an Si-O film having silicon bonded with oxygen, carbon and some hydrogen. Likewise, it does not teach oxygen plasma treatment of a dielectric layer after its formation, and certainly not of a dielectric layer consisting essentially of $(CH_3)_xSiO_y$.

As each reference is lacking in this regard, it is inconceivable that the combination could suggest Applicant's independent claim 1. Accordingly, such should be allowed.

Independent claim 1 also stands rejected as being obvious over a combination of Wang et al. in view of Matsuura. The Examiner relies on col.5, lns.3+ as teaching oxygen plasma exposure of Applicant's claimed layer. However, the teaching there provided is only with respect to stripping photoresist from a over a different material layer from that which Applicant claims. Apparently, there may be some exposure of a material of that which Applicant claims to an oxygen comprising plasma within the illustrated contact openings which are formed. However, the depositing of Applicant's subject layer and the plasma comprising oxygen exposure in Applicant's claim 1 is stated to occur in the same chamber, and such clearly does not occur in the Wang et al. process. Further, Applicant's independent claims 1 and 34 have been amended to recite that such exposing is a blanket exposing with the claims also being amended to emphasize that the dielectric constant of the dielectric layer is reduced by the exposing. Support is inherent from Applicant's specification as filed regarding the same, where clearly the entirety of such layer is shown as being exposed to the subject plasma comprising oxygen. Clearly, such does not occur in the Wang et al. reference, as the subject layer is covered by a different material layer as well as photoresist, and certainly the overall dielectric constant of the subject layer is not reduced by mere exposure of sidewalls of the layer within a contact opening. Accordingly, Wang et al. does not in any way disclose or suggest blanket exposing Applicant's subject dielectric layer in the same chamber within which

it was deposited to a plasma comprising oxygen effective to reduce the dielectric constant of said dielectric layer in the manner which Applicant claims. Matsuura is equally lacking in this regard, as argued above. As each reference is lacking in this regard, it is inconceivable that the combination could suggest Applicant's independent claim 1. Accordingly, withdrawal of this rejection is urged.

Independent claim 1 also stands rejected as being obvious over a combination of Brinker et al. and Matsuura. Applicant disagrees and requests reconsideration.

Brinker et al. is not directed to a chemical vapor deposition process, and accordingly, could not suggest conducting Applicant's recited "exposing" in any chemical vapor deposition chamber, let alone the same one within which the chemical vapor deposition occurs on a subject substrate. Matsuura is inapplicable to Applicant's method as argued above. As each reference is lacking with regard to Applicant's recited chemical vapor depositing and exposing to a plasma comprising oxygen within the same chamber effective to reduce the dielectric constant of the dielectric layer to at least 10% below what it was prior to said exposing, the combination does not suggest that which Applicant claims. Accordingly, withdrawal of the rejection of claim 1 over Brinker et al. in view of Matsuura is requested.

Independent claim 34 differs from claim 1 in reciting the additional limitation of the chemical vapor deposition being plasma enhanced, yet the

deposited layer is recited to comprise $(CH_3)_xSiO_y$ as opposed to requiring "consisting essentially" thereof. Further, claim 34 includes the limitation of the exposing occurring without removing the substrate from the chamber between the depositing and the exposing, with pressure within the chamber being maintained at subatmospheric between the depositing and the exposing. Such claim stands rejected as being obvious over a combination of any of Morita, Wang et al. and Brinker et al. in view of Matsuura and Miyasaka. Applicant disagrees and requests reconsideration.

Morita, Wang et al. and Brinker et al. are inapplicable to amended claim 34 analogously for each of the essential reasons argued above with respect to their inapplicability to claim 1. Matsuura is likely inapplicable to Applicant's amended claim 34 for the same essential reasons argued above with respect to Matsuura's inapplicability to claim 1. Likewise, Miyasaka does not disclose depositing $(CH_3)_xSiO_y$ and exposing such to a plasma comprising oxygen effective to reduce the dielectric constant of such layer. As each of the references is lacking in at least these regards, it is inconceivable that the combination could suggest the narrower attributes of Applicant's independent claim 34. Accordingly, the rejection of claim 34 should be withdrawn, and action to that end is requested.

Applicant's dependent claims should be allowed as depending from allowable base claims, and for their own recited features which are neither shown nor suggested in the cited art. Action to that end is requested.

This application is believed to be in immediate condition for allowance, and action to that end is requested.

Respectfully submitted,

Dated: 5-22-01

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application Serial No. 09/388,826
Filing Date . . . . . September 1, 1999
Inventor . . . . . Weimin Li et al.
Assignee . . . . . Micron Technology, Inc.
Group Art Unit 2813
Examiner . . . . . E. Kielin
Attorney's Docket No. MI22-1208
Title: Low k Interlevel Electric Layer Fabrication Methods

VERSION WITH MARKINGS TO SHOW CHANGES MADE ACCOMPANYING RESPONSE TO MARCH 3, 2001 FINAL OFFICE ACTION

In the Claims

The claims have been amended as follows. Underlines indicate insertions and ~~strikeouts~~ indicate deletions.

1. (Thrice Amended) A low k interlevel dielectric layer fabrication method comprising:

providing a substrate having integrated circuitry at least partially formed thereon;

chemical vapor depositing within a chamber an interlevel dielectric layer consisting essentially of $(CH_3)_xSiO_y$ and having a dielectric constant no greater than 3.5 over said substrate; and

after forming the dielectric layer, blanket exposing said dielectric layer in the chamber to a plasma comprising oxygen without depositing more of

said dielectric layer effective to reduce the dielectric constant of said dielectric layer to at least 10% below what it was prior to said exposing, wherein a whole of the dielectric layer subjected to the exposing is not transformed from one base chemistry to another by the exposing.

Cancel claim 19.

34. (Thrice Amended) A low k interlevel dielectric layer fabrication method comprising:

providing a substrate having integrated circuitry at least partially formed thereon;

in a chamber, plasma enhanced chemical vapor depositing an interlevel dielectric layer comprising $(CH_3)_xSiO_y$ and having a dielectric constant no greater than 3.5 over said substrate at subatmospheric pressure; and

after forming the dielectric layer, blanket exposing said dielectric layer in the chamber to a plasma comprising oxygen at a subatmospheric pressure without depositing more of said dielectric layer effective to reduce the dielectric constant of said dielectric layer by at least 10% below what it was prior to said exposing, the exposing occurring without removing the substrate from the chamber between the depositing and the exposing, and pressure within the chamber being maintained at subatmospheric between the depositing and the exposing, wherein a whole of the dielectric layer subjected to the exposing is not transformed from one base chemistry to another by the exposing.

Cancel claim 47.

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